Effects of baiting lodgepole pines naturally attacked by the mountain pine beetle with *Ips pini* (Coleoptera: Scolytidae) pheromone on mountain pine beetle brood production

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ABSTRACT

Lodgepole pine trees which had been naturally attacked by mountain pine beetle (*Dendroctonus ponderosae* Hopk.) were baited with pine engraver (*Ips pini* Say) pheromone in August and September and the effect on mountain pine beetle brood production was evaluated compared to unbaited controls at four heights. Both bait treatments resulted in significant overall reduction of emerging mountain pine beetles.

Key words: Coleoptera, Scolytidae, pheromone, ipsdienol, lanierone

DISCUSSION

Lodgepole pines (*Pinus contorta var. latifolia* Engelm.) killed by mountain pine beetle (MPB) (*Dendroctonus ponderosae* Hopk.) are often subsequently attacked by a number of less aggressive (secondary) species of bark beetles (Hopping 1961; Wood 1982; Amman and Safranyik 1985), such as the pine engraver (PE)(*Ips pini* Say). This creates potential competition for food and living space. In the laboratory, Rankin (1983) demonstrated the potential for reducing MPB brood survival, of inducing attacks by PE. However, Safranyik *et al.* (1996) found that in trees naturally attacked by MPB, the density of induced PE attacks had only a weak negative correlation with MPB survival at breast height (1.3m). They also showed that the vertical gradients of attack densities by the two species are inversely related. Hence, assessment of the overall impact of PE competition on MPB brood production should be done by sampling at several heights on the infested bole. The objective of this work was to assess the effects of induced attacks by PE on MPB survival in lodgepole pine based on sampling at four heights on the infested bole. On naturally infested lodgepole pine, PE attacks were induced using two commercially prepared bubble capsules containing ipsdienol and lanierone (release rate 0.2 mg/day and 0.02 mg/day, respectively at 20°C)(Phero Tech Inc., Delta, BC, Canada) attached to the north side of the bole at breast height. There were three treatments: control (no bait), baited 14 August, and baited 4 September, 1991. Three trees of similar diameter were selected from each treatment from those used in the study of Safranyik *et al.* (1996). On 9 November 1991, after several days of freezing weather, the trees were felled, 40-cm-long logs were removed from four evenly spaced points along the bole of each tree, individually caged, and kept indoors at 20°C until emergence had ceased. Emerged insects were collected 2-3 times weekly. Attack density was determined by removing two 15cm square samples from each log, or by peeling the whole log. All observations were converted to a square meter basis and counts were transformed to $\sqrt{(X + 0.5)}$ prior to analysis. MPB attacks were analyzed by analysis of variance and counts of emerged adults were analyzed by covariance analysis using attack count as the co-variate. Differences among means were tested by multiple comparison procedures using Tukey's test (SAS

1990) at the 5% probability level. Mountain pine beetle attack density varied significantly among the bait treatments ($F_{2,5}$= 12.50, p< 0.05)(Table 1). Height effects were also significant ($F_{3,15}$= 6.04, p<0.01) as mean attack density decreased with height on the bole (Table 2). This is the usual attack pattern for MPB (Safranyik 1968). There was no

Table 1

Mean densities (±SE) of attacks and emerged mountain pine beetles by bait treatment averaged over bolt height (three trees per treatment).

Bait Treatment per m^2	Attacks per m^2	Emerged Adults
Control	62.96 ± 11.23 a	492.40 ± 102.80 a
August	29.63 ± 6.89 b	181.20 ± 54.81 b
September	72.21 ± 19.64 a	250.12 ± 84.18* b

*Based on 2 trees

Means within columns designated by the same letters are not statistically significant (p> 0.05, Tukey's test)

Table 2

Mean densities (±SE) of attacks and emerged mountain pine beetles by bolt height averaged over bait treatment (total of eight trees sampled).

Bolt Height(m) per m^2	Attack per m^2	Emerged Adults
2	91.67 ± 27.01 a	306.58 ± 135.81 a
8	63.89 ± 7.59 ab	433.76 ± 152.67 a
14	38.89 ± 12.29 ab	276.94 ± 95.49 a
20	16.67 ± 11.10 b	134.34 ± 126.97 a

Means within columns designated by the same letters are not statistically significant (p> 0.05, Tukey's test)

significant interaction between bait treatment and height ($F_{6,15}$= 0.64). One of the trees selected from the September baited group failed to produce any brood, and was dropped from the data set. Covariance analysis of emerged mountain pine beetle density indicated that overall treatment effect was marginally significant ($F_{2,23}$= 3.45, p=0.066) and there was no significant position (height on bole) or position by treatment effect (Table 2). The differences between the control and each of the August and September treatments were significant at p<0.05 (Table 1). The co-variate, mountain pine beetle attack density, was significant ($F_{1,17}$=6.55, p=0.02) and explained 11% of the variation in emerged mountain pine beetle density. Although Safranyik *et al.* (1996) did not find significant differences in MPB attack density at breast height in response to the same bait treatments, our results indicate that PE baits inhibited MPB attacks based on the entire infested bole. Two factors were responsible for significantly reduced brood production in the August bait treatment (Table 1): reduced final density of MPB attacks; and increased host resistance that occurs at lower attack rates, and results in reduced brood survival. However, as MPB attacks substantially ceased by the end of August, the reduced MPB brood production in the September bait treatment was likely caused by direct competition for food and space by MPB and PE brood. Safranyik et al (1996) showed that the density of hibernating PE in the duff (an index of overall PE production in the tree) was significantly greater in the September treatment than in the other two treatments. The results of this work suggest that assessments of competitive interactions between bark beetle species should examine brood production over the entire infested bole and control key tree and attack variables.

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